A Curvature Based Phase Unwrapping Approach for Dense Phase Fringes

Keyword

Mario Costantini
Jet Propulsion Laboratory
4800 Oak Grove Drive, Pasadena, California 91109
E-mail: mc@ampersand.jpl.nasa.gov

Phase unwrapping is the problem of reconstructing a function on a grid given its values modulo 2π. All phase unwrapping techniques start from the assumption that the neighboring pixel differences of the phase function to be reconstructed are less than π, and can then be directly calculated, almost everywhere. When an approximating function for the phase surface to be reconstructed is known, this can be used to modify the original data in order to have the above hypothesis fulfilled in the majority of points. There are still several cases, however, where this classical approach to phase unwrapping is not adequate.

In this work, we explore the possibility of relaxing the hypothesis on the unwrapped phase "discrete" partial derivatives, assuming instead that the "discrete" partial second derivatives of the unwrapped phase are almost everywhere limited by π in absolute value. This property remains often valid in many cases when the same assumption about the first derivatives fails.

The proposed phase unwrapping approach is tested and compared with the classical one on data sets that include Synthetic Aperture Radar (SAR) differential interferometric measurements of fast glacier motion in Greenland and Antarctica. These data present areas characterized by very dense (more than one per pixel) and convoluted phase fringes (Moiré and bull-eyes patterns).

The tests performed show that significant improvements with respect to the standard approach are achieved when the unwrapped phase to be reconstructed is very steep (i.e. the wrapped phase has one or more fringes per pixel); consistent results are obtained with both methods in the other cases.

interferometry